Intimate partner femicide in context: An examination of firearm type across the rural/urban divide

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Abstract

Previous research on intimate partner homicide (IPH) has established that intimate partner homicides are overwhelmingly committed with a firearm. Emerging research suggests the risk of partner violence turning lethal in rural America is often exacerbated by a higher prevalence of firearm ownership, as well as the limited availability of victim support services, economic disadvantages, and access to healthcare services. Given that IPH represents one of the most common types of homicide in rural areas, understanding the prevalence and associated risk and protective factors presents important policy implications. Using county-level data from the Center for Disease Control and Prevention's National Violent Death Reporting System for the years 2015-2016 and controlling for well-established structural correlates of IPH, this research examines the nature and prevalence of IPH across county context. We investigate whether leading predictors of IPH (firearm access, domestic violence support services, and economic disadvantage) are associated with firearm and non-firearm IPH incidents equally and whether these relationships hold when comparing rural and urban counties. We further examine the unique dynamics of firearm specific IPH, including a comparison of IPH incidents committed with handguns versus long guns, given their differing prevalence and cultural context in rural and urban communities. Findings reveal important differences across the rural-urban divide and weapon types. Implications for research and policy are discussed.

Keywords: homicide; rural; intimate partner; femicide; guns; economic disadvantage

Introduction

Recent data from the Centers for Disease Control and Prevention (CDC) reveal that half of all females murdered in the United States are killed by their intimate partners (Petrosky et al., 2017). Most intimate partner violence (IPV) and intimate partner homicide (IPH) research to date has focused on urban areas (Annan, 2008). Yet as of 2010, approximately 19% of the total U.S. population lives in rural areas (U.S. Census Bureau, 2016). In one of the first population-based studies of the prevalence of IPV among the general population, Breiding and his colleagues (2009) estimated approximately 27% of rural women have experienced some sort of lifetime IPV victimization. Though some estimates suggest partner violence rates are similar between rural and non-rural areas (Brieding et al., 2009), the seriousness of partner violence is often exacerbated in rural areas due to social isolation and reduced access to support and healthcare services for victims (Gillespie & Reckdenwald, 2017; Peek-Asa et al., 2011), as well as cultural conditions impacting the reporting and deterrability of violence between intimate partners. This can amount to unique vulnerabilities among rural women, especially those who are divorced or separated (Edwards, 2015). Indeed, prior studies have called for a focus on different measures to capture the qualities of rural environments that affect intimate violence, above and beyond the structural correlates of violence in urban areas (Beyer et al., 2013).

The current study focuses on three features of rural areas often theoretically highlighted as posing unique risk factors for femicide: 1) cultural acceptance and availability of firearms, 2) reduced access to domestic violence (DV) shelters and services, and 3) higher rates of poverty and economic disadvantage. Drawing on data from the CDC for 2015 and 2016, the current paper examines differences in male perpetrated homicide in rural areas, assessing whether these unique risk factors are associated with femicide perpetrated with and without a firearm. Given differences in access and gun ownership in rural areas, we also assess whether there are differences across deaths perpetrated by short guns versus long guns. Data from 2016 suggest that only 5.8% of all homicides committed by a gun involve a shot gun or rifle (Federal Bureau of Investigation [FBI], 2017), however, gun ownership is qualitatively different between rural and urban areas. Given that ownership of a gun is associated with a 500% increase in the risk of IPH (Campbell et al., 2003), we explore whether there are differences by gun type.

Macro-level IPH risk and protective factors

Over the past two decades, emerging scholarship has increasingly recognized the need to understand IPV in rural America. This body of work (e.g., AbiNader, 2020; Breiding et al., 2009; Edwards, 2015; Gallup-Black, 2005; Lanier & Maume, 2009; Peek-Asa et al., 2011; Reckdenwald et al., 2018; Strand & Storey, 2019; Van Hightower & Gorton, 1998) illustrates that residents in rural areas are faced with unique challenges that may increase the risk for partner violence and homicide, such as geographic and social isolation and related challenges including more limited access to important resources and potentially protective mechanisms, such as health care professionals, DV resources, and law enforcement. Rural America faces these challenges while simultaneously experiencing economic disadvantages, lack of health insurance or inadequate health insurance coverage, and transportation and communication constraints

(DeKeseredy & Joseph, 2006; Lanier & Maume, 2009; Websdale, 1998). These all limit the ability of victims of interpersonal violence to seek help from various service providers, which can allow IPV to flourish, and in the most severe cases, escalate to homicide. Research finds IPV tends to be more severe in rural areas and scholars speculate this may be because of these barriers to help-seeking behavior. This, in turn, contributes to waiting longer, and until the situation is more severe, to seek help, if at all (Denham, 2003; Faller et al., 2018; Peek-Asa et., 2011; Strand & Storey, 2019; Van Hightower & Gorton, 2002). This could also explain the higher rates of fatalities as victims of partner violence are not able to get the help they need.

Economic disadvantage

Extant research on IPH and homicide, more broadly, unequivocally finds a strong and persistent effect of economic disadvantage on homicide, including positive associations with both firearm and non-firearm IPH, and in both urban and rural communities (e.g., Diem & Pizarro, 2010; Land et al., 1990; Madkour et al., 2010; Pratt & Cullen, 2005; Reckdenwald et al., 2018; Stansfield et al., 2019; Stansfield & Semenza, 2019). Economically disadvantaged areas are plagued by a number of economic challenges, including a lack of job opportunities and low wages for those who are working, contributing to higher rates of unemployment, a high percentage of families living in poverty, inadequate access to quality health care, as well as a concentration of single-parent families (Stansfield et al., 2019). Additionally, research tends to find the percentage of individuals living in poverty and male unemployment rates are higher in rural areas (Breiding et al., 2009; Lanier & Maume, 2009). After taking county-level economic correlates into account, Lanier and Maume (2009) found male unemployment at the individual level to be a risk factor for IPV, but only in rural counties. In explaining their finding, they go beyond arguments focusing on economic stress related to lack of income and draw on previous work documenting more traditional gender roles in rural areas (e.g., Macmillan & Gartner, 1999; Van Hightower & Gorton, 2002; Websdale, 1998). Lanier and Maume (2009) argue unemployment effects on male-perpetrated partner violence may be amplified in rural areas because it undermines the "male as breadwinner" mentality that prevails.

Furthermore, economic disadvantage may be exacerbated by both geographic and social isolation (Lanier & Maume, 2009; see also Websdale, 1998), amplifying its deleterious effects in rural communities where these types of isolation are ubiquitous. Both geographic and social isolation can make an already perceived "private" matter less noticeable (Websdale, 1998) and scholars have referred to the combined geographic and social isolation many women in rural areas face as a "double-edged sword" of isolation (Lanier & Maume, 2009: 1322). Scholars (e.g., Lee et al., 2003) have likened disadvantage in geographically and socially isolated rural communities to the concentrated disadvantage faced in socially isolated inner-city "hyper-ghettos" that emerged as a result of industrial restructuring (Wilson, 1987) and is consistently linked to higher crime rates in urban areas.

Geographically, rural areas are more remote; they tend to be farther away from resources, including access to health care or DV services and law enforcement may be more limited in remote rural areas (Websdale, 1998). These barriers may reduce the likelihood of a victim of partner violence reporting her abuse or seeking help (Websdale, 1998). Social isolation weakens social support and informal social control (Stets, 1991), which can severely limit opportunities to

seek help. Collective efficacy, which has been found to be a protective mediating factor between economic deprivation and violent crime (Sampson et al., 1997) has a more complex relationship when specifically considering partner violence. Although some studies have found collective efficacy also serves as a protective factor against IPV (e.g., Browning, 2002), others argue that collective efficacy may function differently in rural and urban environments, especially when it comes to partner violence (e.g., DeKeseredy & Joseph, 2006). Instead, these scholars hypothesize increased levels of collective efficacy may *increase* levels of violence against women in rural areas due to the close-knit relationships and strong social ties among residents decreasing a victim's willingness to engage in help-seeking behaviors (see also Ames et al., 2006).

Furthermore, in his book documenting the experiences of female-victim partner violence in rural Kentucky, Websdale (1998) notes "rural family life, gender roles, and patriarchal ideology generate acute forms of socio-cultural isolation that render rural women particularly vulnerable to battering and passive policing" (p. 84). In testing these arguments, Lanier and Maume (2009) found that social isolation was predictive of IPV, but only in rural areas. Contrary to expectations, none of their measures of social support (conceptually the opposite of social isolation) were found to play a significant role in either rural or urban settings.

DV services

Consistent with the exposure reduction hypothesis, DV services, such as DV shelters, legal services, and hotlines, provide battered women with an alternative to escape the abuse before it turns lethal (Browne & Williams, 1989; Dugan et al., 1999, 2003). As a protective factor against IPV escalating, DV services and shelters have been put in place to help victims around the country. However, their presence and accessibility are not equally distributed across communities, and victims in rural areas may have a harder time accessing these services. Research has extensively documented the reduced or non-existent access to DV resources in rural areas (e.g., Grama, 2000). For example, Peek-Asa and colleagues (2011) found that women in rural areas had to travel three times as far as women in urban areas to reach DV services. Not only did the women have to travel further to get to the programs, but when they got there, they usually also had to wait longer than their urban counterparts to receive services due to demand outweighing supply. This has been linked to features including smaller and less adequately trained staff serving multiple counties at a single location, reduced or restricted operating hours, and less space (Eastman & Bunch, 2007; Peek-Asa et al., 2011; Strand & Storey, 2019). Additionally, even when they are in closer geographic proximity, DV services in rural areas have been found to be poorly funded and less inclusive than services offered in urban areas (Edwards, 2015). Despite conceptual reasons DV services should reduce fatalities, empirical evidence is mixed, with some studies suggesting that some DV resources can place some women at greater risk as they face a backlash from aggrieved partners (e.g., Dugan et al., 2003) and others finding DV shelters serving as a protective factor for intimate femicide (Reckdenwald et al., 2018). Ultimately more work is needed that assesses the association of DV shelter access and IPH in both rural and urban areas alike.

Firearm availability

Firearms are the most commonly used weapon in male-perpetrated homicides against female partners (Cooper & Smith, 2011; Petrosky et al., 2017; Violence Policy Center, 2017), being used over 50 percent of the time (Puzone et al., 2000). The availability of a firearm in the home is estimated to increase the risk for IPH from 5 to 8 times compared to households without readily available firearms (Bullock & Cubert, 2002; Campbell et al., 2003; Jeltsen, 2013), as a would-be perpetrator can quickly obtain a firearm without time to "cool down" before acting violently. Increasing the time and effort needed between experiencing aggressive tendencies and being able to execute a violent act has been suggested to reduce both firearm-related IPH (Semenza et al., 2020; Stansfield & Semenza, 2019; Wintemute et al., 2003; Zeoli et al., 2016) as well as firearm-related suicide (Brent & Bridge, 2003).

Although some recent research finds that legal access to firearms is a critical risk factor for firearm-related IPH, this effect is often limited to urban areas (Stansfield & Semenza, 2019; Wiebe et al., 2009). This finding has been interpreted in a couple of different ways, most notably speculation that the higher rate of pre-existing gun ownership in rural areas compared to urban areas renders the presence of a nearby gun store less salient to acting out violence and aggression (Branas et al., 2004; Kadet, 2016; Weisheit et al, 2005; Wiebe et al., 2009). Conversely, in urban areas, the rate of federal firearm licensees (FFLs) may increase ease of access to obtain a firearm having a greater impact on those that do not already own a gun (Semenza et al., 2020; Wiebe et al., 2009). The higher rate of pre-existing gun ownership in rural areas can be partially attributed to the unique "gun culture" that exists in rural areas (Cunningham et al., 2000; Gillespie & Reckdenwald, 2017; Steidley et al., 2017; Websdale, 1998; Wiebe et al., 2009).

This gun culture signifies increased cultural acceptance for owning guns, due to traditional uses in hunting and sport, heritage and sentimental values associated with guns and guns passed down from generation to generation, and the idea of growing up around guns (Azrael et al., 2004; Williams, 2003). While rural residents are more likely to report owning guns for hunting or sport or sentimental reasons, urban residents are more likely to report owning guns for protection (Kadet, 2016). However, rural residents have also voiced the need to own guns for protection, especially in areas where law enforcement is scarce and residents feel they must rely on themselves for protection (Banksten & Thompson, 1989; Beyer et al., 2015; Bogus, 2008; Hemenway et al., 2001; Jiobu & Curry, 2001; Weisheit et al., 1994). Given the different reasons for owning guns, research suggests different gun *types* may be owned. More gun owners reported owning handguns for self-defense (Hepburn et al., 2007; Kadet, 2016) while owning long guns for hunting and sport (Cunningham et al., 2000; Hepburn et al., 2007; Kadet, 2016). However, because hunting is a more traditional past-time in rural areas, we tend to see more long guns in rural areas (Hanlon et al., 2019).

Alternatively, it may be that FFLs are not a good proxy for firearm availability in rural areas, where there are other legal ways to obtain firearms, including private sales or gun shows, not as readily available in urban areas (Stansfield & Semenza, 2019). In the first study to examine the relationship between FFLs and gun homicides, Wiebe et al. (2009) also compared their FFL measure to the more commonly used proxy for firearm availability, the ratio of suicides committed with a firearm to all suicides (FS/S). They found a moderately strong

correlation between the two gun measures in major cities (r=0.67) but a low correlation in smaller cities, suburbs, and small towns (r=0.32, r=0.16, and r=0.07, respectively) and go on to suggest that FFLs may not be an appropriate proxy for gun availability in rural areas.

The current study

Using National Violent Death Reporting System (NVDRS) data on the 27 states that reported to the CDC in 2015 and 2016, we aggregate victim-level data to the county level for analysis and to allow for rural-urban comparisons. Specifically, the current research is interested in the effect of three key predictors – economic disadvantage, DV shelters, and gun store density – on intimate femicides committed with different types of weapons across the rural-urban divide. Extant research has demonstrated the unique risk factors in rural communities, particularly as it pertains to partner violence, as well as differences in predictors when comparing firearm and non-firearm IPH. However, less research has been conducted on the *type of firearm* specifically. From the limited research that has been done, studies suggest living in a rural area is an important predictor of long-gun ownership (Kadet, 2016) as rural areas are more likely to have long guns, such as rifles and shotguns, for hunting purposes. Despite documented differences in ownership, to date, no study has examined the distinction between handguns and long guns in rural/urban IPH comparisons.

Methods

Data and sample

Data for our dependent variables comes from the NVDRS maintained by the CDC. The NVDRS captures all violent deaths (homicides and suicides) for 27 states within the U.S.[1] While it is not nationally representative, it is advantageous because it combines detailed information from death certificate data with information from autopsy reports and police records, giving a more complete picture of the incident (Karch et al., 2012; Regoeczi & Banks, 2014). For our purposes, it is also advantageous because it provides more detailed information on firearm type, with less missing data than comparable mortality statistics (Hanlon et al., 2019). It also has more complete and accurate data than official data sources, such as the Uniform Crime Reports, which is based on voluntary submission from law enforcement agencies and may be biased against smaller agencies reporting (Felson & Paré, 2010).

We used data from 2015-2016 (the most recent data available) and combined two years of data given the rarity of the event. The initial NVDRS is a victim-level file and contained 17,751 records. We aggregated this to the county level based on residence FIPS codes. We then matched this data with data on all 1455 counties in the 27 states. Because reporting is mandatory, we can assume all counties that had homicides are represented in the original data file, and counties not in the NVDRS did not experience any homicides in 2015 or 2016. As such, we replaced homicide data for missing counties with zero homicides. This is especially important given the rarity of the event and our focus on rural areas, where it is quite possible that no homicides occurred during 2015 or 2016. Table 2 and Appendix A note the total number of counties with zero intimate femicides for each of our dependent variables and samples.

There is no agreed upon way to define or operationalize the rural-urban divide (Annan, 2008; Parker & Reckdenwald, 2008). While a variety of operationalizations have been used in the literature, after conducting a systematic review of 50 studies on IPV in rural areas, Annan (2008) noted "Many of the rural IPV studies reviewed defined rural using the U.S. Census Data" (p. 90). Similarly, we define rural areas using the Census definition. Counties are classified as rural if more than 50% of the population lives in a rural area and classified as urban if less than 50% of the county population lives in a rural area.

Dependent variables

Our primary focus is on IPH. Because of differing dynamics when females kill their intimate partners and within same sex couples, we limit our analysis to just those intimate homicides with a male perpetrator and female victim (i.e., intimate femicide). We use the intimate partner dummy code available in the NVDRS to identify IPH cases. In addition to male-perpetrated homicides against female intimates, we are also interested in the weapon used. Specifically, we analyze five dependent variables: all IPH, IPH committed with a firearm (any type), IPH committed with a weapon other than a firearm, IPH committed with a handgun, and IPH committed with a long gun (i.e., rifle or shotgun).

Independent variables

Data for our independent variables come from several different sources. The social, economic, and demographic variables come from the American Community Survey 5-year estimate (2012-2016) available through the National Historical Geographic Information System (NHGIS). Sources for the other independent variables are noted below.

Economic disadvantage

Our measure of economic disadvantage is consistent with previous aggregate IPH studies (e.g., Stansfield et al., 2019). We conducted factor analysis with oblique rotation and created a factor with weighted factor loadings. The variables included in the *Economic Disadvantage Index* are percent of female-headed households with children, percent of families living in poverty, percent of the civilian labor force that is unemployed, percent Black, percent of the population 18 and over without health insurance, and the Gini index of income inequality. Factor analysis revealed these structural predictors all load together onto a single factor with factor loadings all greater than 0.50 and an Eigenvalue of 2.93. Given previous work suggesting a tipping point for economic disadvantage on homicide (Hannon, 2005; Hannon & Knapp, 2003; Krivo & Peterson, 2000; Lee et al., 2003; McNulty, 2001), we also include the squared term of our economic disadvantage index to capture a possible curvilinear relationship.

DV shelters

We include a measure for the rate of DV shelters located within the county. Counts of DV shelters were retrieved from domesticshelters.org. These data were only available at the city level, so we used the city to approximate the county where it was located. When multiple counties served the same city, we used the zip code listed on the individual DV services'

webpage to assign it to a specific county. This measure was calculated as a rate per 100,000 county residents and logged to reduce skewness.

Firearm availability

Following recent studies on legal firearm acquisition (e.g., Semenza et al., 2020; Stansfield & Semenza, 2019; Wiebe et al., 2009), firearm availability is captured via the rate of federal firearm licensees per 100,000 residents. The number of federal firearm licensees, which includes the number of licensed importers, pawnshops, and sellers of firearms was obtained from the Bureau of Alcohol, Tobacco, Firearms, and Explosives' (ATF) list of federal firearms licensees as of December 2015. We calculated a rate per 100,000 residents and logged the variable to reduce skewness. As noted above, this measure has been increasingly used in recent research as a proxy for firearm availability. However, we also include a state-level measure of the percentage of suicides committed with a firearm as a more traditional proxy for firearm availability.

Control variables

We also control for several other variables important in existing macro-level research on IPH, including percent young males (percentage of males 15-29 years of age), divorce (percent of divorced males aged 15 and over), and a *Hispanic Immigration Index* comprised of the percent of the population that is Hispanic and the percent foreign-born. The Hispanic Immigration Index is consistent with previous macro-level research on homicide (Ousey & Kubrin, 2018) and may be especially relevant for our examination of rural/urban differences given research that has established immigration into certain areas (e.g., sanctuary cities) serves as a protective factor against violence (Harris & Feldmeyer, 2013; Ousey & Kubrin, 2018; Shihadeh & Barranco, 2010). This same protective factor may not exist in rural communities, but nonetheless, the Hispanic population in the U.S. has grown substantially in recent decades, especially in rural areas (Parker & Reckdenwald, 2008). As with the *Economic Disadvantage Index*, the *Hispanic Immigration Index* was created using weighted factor loadings and had an Eigenvalue of 1.18. Consistent with previous macro-level research on IPH, we also control for the non-IPH rate per county (logged to reduce skewness) (Semenza et al., 2020; Stansfield & Semenza, 2019). Finally, we include two state-level dummy controls: whether the county is in a state with a Mandatory Arrest Law for DV and whether the county is in a state located in the South. The South is associated with elevated levels of both IPH and greater firearm concentration (Felson & Paré, 2010; Hepburn et al., 2007; Johnson et al., 2004; Reed, 1982). There are also regional differences in the *type* of firearm ownership (Felson & Paré, 2010), with long guns being more prevalent in the South compared to other regions. States were identified as being in the Southern region based on the U.S. Census Bureau's definition.[2]

Analytic strategy

Given that our dependent variables are counts, exhibiting evidence of overdispersion, we use negative binomial regression techniques. We perform analyses for all 5 of our dependent variables across 3 samples: all counties (n=1455), rural counties only (n=863), and urban counties only (n=592). Additionally, we offset each of the models by the natural log of the resident population, essentially converting our count dependent variables into a rate (Osgood,

2000). Given counties are nested within states and some of our predictor variables are measured at the state-level, we also use multi-level mixed effects negative binomial models. While we do acknowledge there are a lot of zeros (see Table 2 and Appendix A), it is not possible to run a multi-level zero-inflated negative binomial model. Therefore, we also ran zero-inflated negative binomial models (ZINB) with state-clustered standard errors and the results are largely the same as those reported here (available upon request). Before estimating our multi-level mixed effects negative binomial models, we examined bivariate correlations and Variance Inflation Factors (VIFs) for all the independent variables. After the creation of the two indices (discussed above), we did not observe any potential issues with multicollinearity and the VIFs for each of the samples are reported in Table 1.

Results

Descriptive statistics: Intimate femicide and community characteristics in rural and urban counties

Table 1 presents descriptive statistics for all counties, rural counties, and urban counties. Our primary focus here is on a comparison between the rural and urban samples. However, we provide descriptive statistics for the combined sample for the interested reader and comparison purposes. To examine differences in prevalence and risk and protective factors across contexts, we also performed two-sample t-test comparisons between the rural and urban subsamples. Unsurprisingly, given the larger population base, descriptive statistics reveal significantly higher counts for each of the dependent variables in urban counties. When taking county population into account, however, rates for each type of intimate femicide in rural counties were higher than in urban counties, although not significantly higher (except for long gun intimate femicide). In fact, of the 30 counties in our sample with the highest IPH *rates*, 25 of the 30 counties were located in rural areas and 27 of the 30 had populations under 20,000 residents (Appendix B; see also Kposowa & Breault, 1993).

When it comes to the economic disadvantage index, the mean in rural and urban counties is approximately the same and t-tests confirmed there is not a statistically significant difference. However, t-tests do reveal important and statistically significant differences between counties for each of the index *components*. Specifically, and as expected, rural counties have a statistically higher percentage of families living in poverty, unemployment, and population without health insurance as compared to urban counties. Conversely, urban counties have a statistically significantly greater percentage of Black residents, female-headed households with children, and income inequality. When considering the DV shelter rate, descriptive statistics are consistent with the previous literature and confirm there are significantly more DV shelters per capita in urban counties. Additionally, the gun store rate is significantly lower in urban counties, as is the percentage of suicides committed with a firearm, both in line with expectations. T-test comparisons also reveal statistically significant differences in our control variables with a statistically higher percentage of young male residents, elevated levels of Hispanic immigration (via both the percent Hispanic and percent foreign-born), higher non-IPH rates, and more urban counties located in states with Mandatory Arrest policies. Conversely, rural counties have a significantly higher percentage of divorced males and are significantly more likely to be in a Southern state.

Table 1: Descriptive Statistics by County Sample

	All Counties (N=1455)		Rural Counties (N=863)		Urban Counties (N=592)		
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	*t*
Intimate Femicide, 2015-2016							
Overall (count)	0.848	2.06	0.246	0.547	1.73	2.96	14.35***
Rate	1.03	2.67	1.10	3.10	0.914	1.85	-1.33
Firearm (count)	0.513	1.35	0.161	0.424	1.027	1.952	12.61***
Rate	0.605	1.82	0.667	2.25	0.515	0.908	-1.56
Nongun (count)	0.325	0.934	0.079	0.298	0.684	1.34	12.80***
Rate	0.408	1.95	0.419	2.18	0.392	1.56	-0.266
Handgun (count)	0.381	1.03	0.115	0.360	0.770	1.48	12.51***
Rate	0.437	1.53	0.470	1.88	0.390	0.788	-0.971
Long gun (count)	0.067	0.306	0.032	0.184	0.117	0.421	5.19***
Rate	0.115	0.907	0.152	1.15	0.062	0.277	-1.854*
County-Level Measures							
Disadvantage Index	35.72	16.78	36.32	17.50	34.85	15.66	-1.63
% Black	9.55	14.45	8.84	14.97	10.57	13.61	2.25*
% FHH	8.23	2.86	7.89	2.98	8.72	2.61	5.46***
% Family Poverty	11.75	5.65	12.54	6.01	10.61	4.86	-6.47***
% Unemployed	7.28	3.05	7.42	3.36	7.09	2.52	-1.99*
% No Insurance	13.16	5.69	13.99	6.05	11.95	4.88	-6.84***
Gini	0.442	0.035	0.440	0.034	0.445	0.035	2.87***
DV Shelter Rate (lg)	0.468	0.672	0.415	0.732	0.546	0.564	3.65***
Gun Store Rate (lg)	3.74	0.873	3.97	0.832	3.39	0.813	-13.31***
% Young Males	9.83	2.52	9.16	1.80	10.81	3.06	12.87***
% Divorced Males	11.06	2.66	11.64	2.60	10.22	2.51	-10.41***
Immigration Index	8.68	9.96	5.68	6.76	13.05	12.04	14.89***
% Hispanic	7.56	10.38	5.23	7.69	10.95	12.63	10.71***
% Foreign-Born	4.72	5.42	2.83	3.12	7.48	6.71	17.76***
Non-IPH Rate (lg)	1.52	1.18	1.38	1.28	1.73	0.984	5.67**
Total Population (lg)	10.45	1.42	9.74	1.02	11.48	1.29	28.75***
State-Level Measures							
% Gun Suicides	51.70	10.22	53.49	8.65	49.05	11.68	-8.33***
Mand Arrest (dummy)	42.61%		36.96%		50.84%		5.30***
South (dummy)	45.29%		50.29%		38.00%		-4.66***

Multivariate models: Predicting intimate femicide by weapon and county type

Table 2 presents the full results with separate models for all 5 of our intimate femicide dependent variables (overall, firearm, non-gun, handgun, and long gun) for rural counties and urban counties. We also provide results for the full sample of rural and urban counties combined

for comparison purposes (see Appendix A). Our discussion of results focuses on the five weapon-specific dependent variables and two county types.

All weapons intimate femicide

Table 2 contains results for all male-perpetrated intimate partner femicide for rural counties (Model 1) and urban counties (Model 2), regardless of weapon type. Consistent with expectations, disadvantage increases overall IPH across rural and urban counties, alike. In fact, this is the only variable to reach statistical significance in rural counties. It also appears the relationship is curvilinear in urban counties, as indicated by the negative and statistically significant squared term. Results in Model 2 further show that divorce and the gun store rate (via FFLs) are risk factors in urban areas. Despite the importance of the gun store rate on overall IPH in urban counties, counties in states with more firearm ownership (via the gun suicide rate) did not experience higher IPH in either rural or urban counties.

Firearm intimate femicide

When examining predictors of intimate femicide committed with a firearm (of any type), results in Models 3 and 4 of Table 2 reveal important differences in several key predictors across county context. For example, none of the variables reached significance at the $p<.05$ level in rural counties. Economic disadvantage and the percent of gun suicides are marginally significant ($p=.076$ and $p=.064$, respectively), indicating they might present some risk factors in rural counties. Conversely, the major risk factor in urban counties is gun availability (via both the rate of FFLs and the percentage of suicides committed with a firearm). There are also some consistencies in that Hispanic immigration, divorce, percent young males, and the DV shelter rate are unrelated across rural-urban samples. None of the included measures served as a protective factor against firearm-related intimate femicide in either rural or urban counties.

Non-gun intimate femicide

When focusing specifically on intimate femicide committed without a firearm (Table 2, Models 5 and 6), we again find that none of the included measures influence this type of intimate femicide in rural counties. While not significant predictors in rural counties, both economic disadvantage and divorce increase the risk of non-gun IPH in urban counties, consistent with the literature on IPH more broadly. The gun store rate was also not predictive of non-gun IPH in either rural or urban counties. Conversely, results do reveal that gun ownership as measured via the percent of gun suicides, significantly decreases non-gun IPH in urban counties. The DV shelter rate served as a protective factor in urban counties only, decreasing the risk of non-gun IPH.

Handgun intimate femicide

Turning to the firearm-specific models, results in Models 7 and 8 reveal several similarities with the all firearms model for urban counties. Specifically, we find that the gun store rate and percent gun suicides significantly increase handgun IPH in urban counties. After accounting for these gun-related predictors, none of the other predictor variables significantly

impacts handgun IPH in urban counties. However, unlike the overall firearm IPH model for rural counties, we find that economic disadvantage is associated with an increase in handgun IPH in rural counties, but this relationship is curvilinear, increasing to a point and then the effects level off. Again, none of the other predictor variables impacted handgun IPH in rural counties, although the percentage of suicides committed with a firearm comes close to reaching statistical significance (p=.056). Therefore, except for economic disadvantage, there is not much difference between the all firearms models and the handgun specific models. This is likely because the vast majority of firearm-related intimate femicides are perpetrated with a handgun (73% in rural counties and 85% in urban counties).

Long-gun intimate femicide

Focusing on intimate femicides committed with a long gun (Models 9 and 10) results again reveal the salience of FFLs in urban counties, with a one unit increase in the logged FFL rate associated with a 91% increase in intimate femicides committed with a long-gun. Contrary to expectations and results in the previous models, disadvantage is inversely associated with long-gun IPH in rural counties. Results indicate this relationship may be curvilinear, as well, but with concentrated disadvantage *increasing* long-gun IPH in rural counties. None of the other covariates significantly predicted long-gun IPH. We must caution readers, however, to interpret these results with caution based on the small number of counties that had intimate femicides committed with a long gun. Furthermore, even within those counties, the counts of intimate femicides are extremely small (with 6 being the max).

Comparing across models

We now turn our attention to how the common predictors fare across models (i.e., across weapon type and county type). We find economic disadvantage is associated with a firearm and overall IPH in rural counties, but not non-gun IPH. Contrary to expectations, however, disadvantage was negatively associated with long-gun IPH in rural counties. Additionally, there is minimal evidence of a tipping point in rural counties, with the squared term only being significant in the handgun IPH models. It is unrelated to any weapon-specific type of intimate femicide in urban counties but has a curvilinear relationship with all weapon intimate femicide. With few exceptions, common predictors, including Hispanic immigration, the DV shelter rate, divorce, young males, Mandatory Arrest laws, and Southern region are unrelated to IPH across weapon-types and county context (the only exception is for non-gun IPH in urban counties, where divorce serves as a risk factor and the DV shelter rate serves as a protective factor). In line with previous research, the gun store rate is positively associated with all firearm IPH in urban areas and unrelated to non-gun IPH in urban counties. Also, in line with previous research, the gun store rate is unrelated to IPH in rural counties across models. Inconsistent with expectations, we also find the other proxy measure for gun availability, percent of suicides committed with a firearm, is also unrelated to IPH regardless of weapon type in rural counties. After taking the other covariates into account, results reveal Southern region and Mandatory Arrest laws are not associated with IPH in any of the models.

Table 2: Multi-Level Mixed Effects Negative Binomial Intimate Femicide Regression Models by County Sample. Incident Rate Ratios and (Standard Errors) Reported

	Overall		Firearm		Nongun		Handgun		Longgun	
	Model 11 Rural	Model 12 Urban	Model 13 Rural	Model 14 Urban	Model 15 Rural	Model 16 Urban	Model 17 Rural	Model 18 Urban	Model 19 Rural	Model 10 Urban
County-Level										
Disadv Index	1.057 (.028) *	1.034 (.014) *	1.058 (.033) +	1.029 (.018) +	1.056 (.052)	1.042 (.022) *	1.167 (.052) ***	1.023 (.019)	0.893 (.051) *	1.067 (.069)
$Disadv^2$	0.999 (.000)	0.999 (.000) *	0.999 (.000)	0.999 (.000) +	0.999 (.001)	0.999 (.000) +	0.999 (.000) **	0.999 (.000)	1.001 (.001) *	0.999 (.001)
DV Shelter Rate (lg)	1.001 (.113)	0.897 (.112)	1.004 (.137)	1.051 (.163)	1.064 (.215)	0.651 (.134) *	1.020 (.161)	0.951 (.169)	1.108 (.344)	1.249 (.498)
Gun Store Rate (lg)	1.164 (.195)	1.246 (.094) **	1.372 (.287)	1.302 (.126) **	0.858 (.214)	1.153 (.131)	1.469 (.365)	1.348 (.146) **	1.038 (.420)	1.906 (.561) *
% Young Males	0.975 (.050)	1.033 (.019) +	0.943 (.062)	1.021 (.024)	0.997 (.088)	1.057 (.032) +	0.970 (.071)	1.010 (.027)	0.885 (.131)	1.062 (.060)
% Div Males	0.995 (.037)	1.060 (.028) *	1.030 (.045)	1.011 (.034)	0.938 (.064)	1.149 (.047) ***	0.977 (.051)	0.981 (.036)	1.106 (.104)	1.027 (.095)
Hisp Imm Index	1.016 (.012)	1.001 (.003)	1.013 (.014)	0.996 (.004)	1.032 (.021)	1.006 (.005)	1.011 (.016)	0.996 (.005)	1.037 (.030)	0.991 (.014)
Non IPH Rate (lg)	1.026 (.082)	1.172 (.087) *	1.053 (.100)	1.286 (.121) **	0.905 (.128)	1.012 (.116)	0.918 (.099)	1.274 (.136) *	1.545 (.374) +	1.204 (.302)
State-Level										
% Gun Suicides	1.012 (.012)	0.999 (.005)	1.031 (.017) +	1.018 (.006) **	1.009 (.020)	0.976 (.006) ***	1.039 (.021) +	1.022 (.007) ***	0.985 (.031)	0.991 (.016)
Mandatory Arrest	0.726 (.141) +	0.923 (.086)	0.745 (.174)	1.009 (.114)	0.719 (.254)	0.790 (.117)	0.634 (.183)	0.867 (.105)	0.935 (.494)	0.813 (.263)
South	0.654 (.164) +	1.064 (.128)	0.656 (.204)	0.992 (.146)	0.699 (.317)	1.144 (.213)	0.504 (.184) +	0.875 (.137)	1.852 (1.34)	1.194 (.502)

N	863	592	863	592	863	592	863	592	863	592
# zero obs	690	262	741	328	801	389	774	367	836	535
LL	-484.4	-760.6	-35.80	-602.7	-234.6	-491.1	-277.5	-525.6	-114.4	179.45

Note: All models are offset by the logged population and coefficient constrained to 1 (not shown).
+p<.10; *p<.05; **p<.01; ***p<.001

Discussion and conclusion

Several important findings emerged from these analyses. Descriptive statistics confirmed that rural counties in our sample had a lower rate of DV shelters and a higher rate of licensed firearm dealers compared to urban counties. Additionally, although the total count of intimate femicide was significantly higher in urban counties, rural counties in our sample had higher rates of total intimate femicide, including a significantly higher rate of femicide perpetrated with a rifle or shotgun.

Although these descriptive statistics confirm the very real concern about rural intimate partner femicide, many of the structural predictors examined in this paper did not aptly explain IPH in rural areas. As an example, the licensed firearm dealer rate was a salient predictor of firearm-related intimate femicide in urban counties, but unrelated to femicide in rural areas. As discussed elsewhere (Wiebe et al., 2009), it is likely that FFLs are a poor proxy for gun availability in rural areas, where existing gun ownership may be higher and there exists several other legal ways to purchase guns. Thus, while the findings speak to the importance of provisions preventing DV offenders obtaining guns in urban counties, better measures of gun availability in rural counties are required. While there have been some excellent recent attempts at measuring gun availability (e.g., Schell et al., 2020), adequately capturing gun availability at the neighborhood, city, or county level has remained a persistent challenge for researchers in this area.

Results across models and samples also illustrate the limited role of the DV shelter rate. The DV shelter rate may not have played as important a role as thought because this research specifically examined male-perpetrated violence against women. As indicated by the steeper decline in male-victim IPH in the aftermath of increased services for abused women, previous research has confirmed that DV shelters and resources are more beneficial for male victims of IPV, as they offer the abused woman the ability to escape the relationship before resulting to lethal violence (Browne & Williams, 1989; Dugan et al., 1999, 2003; Reckdenwald & Parker, 2012). While our results cannot confirm this as we do not include data on male victims of IPH, the lack of an impact of the DV shelter rate across models (except for a significant protective effect on non-gun intimate femicides in urban counties) suggests that may be the case here too.

Several other results pertaining to intimate femicide in rural counties are worth noting. The association between economic disadvantage and homicide is well established in the existing literature, although largely confined to the urban context. Our findings confirm that higher economic disadvantage is also associated with higher intimate femicide, and more femicide perpetrated with weapons other than firearms, in urban counties. The fact that economic disadvantage was found to have a robust relationship with intimate femicide in rural counties underscores the need to address broader structural changes, particularly in rural areas. Like urban areas, policies directed at ameliorating the effects of broader structural changes, including decreasing the geographic and social isolation, appear to be a pressing concern for reducing IPH in rural communities.

While this research has illuminated several important findings, it is not without its limitations. First, although the CDC's NVDRS offers numerous advantages over other data sources, including the Supplemental Homicide Reports, the years selected for this study limited us to a sample of 27 states rather than a national sample. Despite this limitation, it still proved the most valuable data source to obtain the richness of information we needed for this analysis. Another limitation is the small number of counties that experienced intimate femicides committed with long guns during the 2015-2016 period. While we performed multivariate analyses on these counties, we recommend caution in interpreting these results given the rarity of this event.

It is also clear that there are several cultural and structural conditions in rural areas that are not being captured by traditional quantitative modeling of IPH. As rural areas continue to see persistence in lethal partner violence over time, even in the face of declining homicide overall (e.g., Gallup-Black, 2005; Jennings & Piquero, 2008), new techniques may be required to help assess how access to service providers, including distance from resources, availability of public transport, and density of social networks impacts the risk of violence escalation, as opposed to simply the number or rate of DV resources available (e.g. Peek Asa et al., 2011). Similarly, rather than traditional measures of poverty and economic hardship, studies may seek to assess how staffing and resource levels at rural health care facilities contribute to violence persistence, especially as researchers begin to uncover the financial effects of the COVID-19 pandemic on rural healthcare systems. Finally, we also acknowledge that the focus on homicide ignored a much larger rural health crisis of non-lethal DV. Researchers may consider whether there are other significant health differences (both physical and mental) among survivors of partner violence in rural versus urban areas. Nevertheless, as homicide is one of the most consistently reported and recorded violent incidents between partners, this study offers an important reminder about the elevated risk for lethal violence in rural America.

Endnotes

[1] The 27 states are Alaska, Arizona, Colorado, Connecticut, Georgia, Hawaii, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Utah, Vermont, Virginia, and Wisconsin.

[2] States classified as Southern and included in our analysis include Georgia, Kentucky, Maryland, North Carolina, Oklahoma, South Carolina, and Virginia.

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Appendix A: Multi-Level Mixed Effects Negative Binomial Intimate Femicide Regression Models for All Counties. Incident Rate Ratios and (Standard Errors) Reported.

	Model 1 Overall	Model 2 Firearm	Model 3 Nongun	Model 4 Handgun	Model 5 Longgun
County-Level					
Disadvantage Index	1.041	1.039	1.042	1.052	0.965
	(.012)***	(.015)**	(.019)*	(.018)**	(.035)
$Disadv^2$	0.999	0.999	0.999	0.999	1.000
	(.000)**	(.000)*	(.000)$^{+}$	(.000)**	(.000)
DV Shelter Rate (lg)	0.964	0.998	0.882	0.968	1.104
	(.079)	(.099)	(.123)	(.111)	(.261)
Gun Store Rate (lg)	1.228	1.285	1.117	1.285	2.024
	(.076)***	(.099)***	(.109)	(.112)**	(.435)***
% Young Males	1.022	1.018	1.042	1.012	1.046
	(.018)	(.022)	(.029)	(.024)	(.055)
% Divorced Males	1.036	1.020	1.078	0.991	1.059
	(.021)$^{+}$	(.026)	(.036)*	(.029)	(.069)
Hisp Imm Index	1.002	0.998	1.006	0.997	0.998
	(.003)	(.004)	(.005)	(.005)	(.012)
Non IPH Rate (lg)	1.129	1.182	1.035	1.113	1.349
	(.059)*	(.077)**	(.087)	(.081)	(.230)$^{+}$
State-Level					
% Gun Suicides	1.003	1.020	0.983	1.025	0.988
	(.004)	(.006)***	(.006)**	(.007)***	(.014)
Mandatory Arrest	0.873	0.952	0.780	0.816	0.873
	(.074)	(.097)	(.106)$^{+}$	(.091)$^{+}$	(.244)
South (dummy)	0.943	0.918	1.004	0.802	1.450
	(.104)	(.121)	(.173)	(.115)	(.528)

N	1455	1455	1455	1455	1455
# zero obs	952	1069	1190	1141	1371
Log Likelihood	-1250.94	-963.58	-735.08	-812.15	-301.34

Note: All models are offset by the logged population and coefficient constrained to 1 (not shown).
$^{+}$p<.10; *p<.05; **p<.01; ***p<.001

Appendix B: Top 30 Counties with Highest IPH Rates and Urban/Rural Classification, Listed by Overall IPH Rate per 100,000.

Rank	County, State	Overall IPH Rate	Total Population
1.	Harper County, OK*	26.42	3,785
2.	Mora County, NM*	21.75	4,598
3.	Dewey County, OK*	20.57	4,862
4.	Mahnomen County, MN*	18.25	5,480
5.	Lincoln County, CO*	18.13	5,515
6.	Crowley County, CO*	18.06	5,537
7.	**Sierra County, NM**	**17.48**	**11,442**
8.	Greer County, OK*	16.44	6,081
9.	Prince of Wales-Hyder Census Area, AK*	15.69	6,374
10.	Beaver County, UT*	15.54	6,437
11.	Madison County, VA*	15.24	13,122
12.	**Galax County, VA**	**14.58**	**6,858**
13.	Lac qui Parle County, MN*	14.50	6,916
14.	Atoka County, OK*	14.44	13,847
15.	King William County, VA*	12.37	16,156
16.	Oscoda County, MI*	11.94	8,374
17.	Gallatin County, KY*	11.71	8,543
18.	**Socorro County, NM**	**11.54**	**17,324**
19.	Seminole County, GA*	11.50	8,696
20.	Bethel Census Area, AK*	11.18	17,885
21.	Jenkins County, GA*	11.04	9,055
22.	Southampton County, VA*	10.93	18,291
23.	Montmorency County, MI*	10.73	9,317
24.	**Grant County, NM**	**10.39**	**28,879**
25.	Nome Census Area, AK*	10.12	9,879
26.	Wilkes County, GA*	10.08	9,924
27.	Metcalfe County, KY*	10.02	9,983
28.	Yellow Medicine County, MN*	9.96	10,038
29.	**Sumter County, GA**	**9.66**	**31,070**
30.	Clay County, KY*	9.45	21,160
	AVERAGE FOR ALL 1455 COUNTIES	1.03	

*indicates rural county; bold indicates urban county